

# Youth Conceptions of Making and the Maker Movement

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## 1. ABSTRACT

In this paper, we report on how young people involved in an out-of-school “maker” club think about making, the maker movement, and themselves as makers. The paper draws from interviews of seventeen young club members. The data are drawn from a larger, ongoing study on youth making. Specifically, we consider how these young people responded to questions that asked them if they are makers, and what kinds of making they like to do. Preliminary results suggest three themes from youth responses: 1) the maker community is open, but requires active participation; 2) making is an activity that is out of the ordinary; and 3) making and learning about making are integrated across contexts. Given these themes, we caution against narrow views of the value of making, and instead advocate a holistic, youth-centered view of making as an educative experience. We conclude with a description of future research plans.

## Categories and Subject Descriptors

H.1.2 [Models and Principles]: User/Machine Systems – *human factors*.

## General Terms

Design, Human Factors, Theory

## Keywords

out-of-school, STEAM, maker, youth, identity, adaptive expertise

## 2. INTRODUCTION

In this paper, we report on how young people involved in an out-of-school “maker” club think about making, the maker movement, and themselves as makers. The youth in our study participate in a club centered on youth-driven, do-it-yourself engineering and design projects. They work for several months in small groups, together with adult mentors, to create projects of their own design, with a goal of exhibiting their projects at a large regional exposition alongside projects from hobbyist and professional adult makers.

This paper is situated within a broader study which examines two issues. First, it looks at these clubs as contexts for the development of adaptive expertise [4] within science, technology, engineering, art, and mathematics (STEAM). Second, it looks at how youth understand themselves as participants in the so-called “maker movement,” and how their understanding may change with time and experience. Here, we focus on this latter issue. Specifically, we consider how young people in these clubs responded to questions that asked them if they are makers, and what kinds of making they like to do.

After a brief review of related work, we present three emergent themes drawn from the interview data, along with illustrative examples. We conclude with implications for future research on youth makers.

## 3. RELATED WORK

It has long been known that children and youth can learn by playing and building with interesting materials [9]. Making and building can foster learning in a variety of ways. For example, testing our ideas out in the world allows us to check expectations against reality, a process that can create conceptual disequilibrium, which can in turn lead to conceptual adaptation [11]. Physical creations can also create a context for social engagement around a shared endeavor. This can bring more and less experienced participants together around a common task – an often fruitful learning configuration [7, 13].

Making things invariably involves tools, and thus is always technical in the broad sense, but special attention has been paid to the constraints and affordances of having young people work with computer and digital technologies. Much of the technology youth encounter in day to day life has a black box quality: it works (usually), but its workings are hidden. Tech savvy youth are often those who excel at dealing with breakdowns in technology, or who actively disassemble black box technologies to see how they work.

A number of researchers have developed digital materials and artifacts that are specifically designed to allow young people access to the inner workings of sophisticated technologies [10]. Programmable blocks, for example, allow children to build, explore, and program with materials that can sense and act in the world in a contingent and interactive fashion [12]. These digital toolkits have greatly lowered barriers to engaging in physical computing, while still offering robust pathways for learning about engineering and programming through design and play. More recent advancements in microcontrollers and rapid prototyping technologies have further increased the sophistication that is possible in such projects, while maintaining relatively low barriers to entry. Digital Fabrication Labs [2] can provide youth with access to and training in such technologies, allowing them to extend their existing creativity and skills into digitally infused and fabricated projects, and at the same time providing occasions to use (and thus learn) STEM principles.

The advent of the “Maker Movement” has created a similar shift outside of the educational researcher’s lab. Long standing hobbies and crafts such as woodworking, sewing, and electronics have been reinvigorated and opened up by the advent of digital fabrication tools and the creation of websites and online social networks that make it easy to share, critique, and compare ideas and project information. While the maker movement is characterized by adult participation, barriers to youth involvement, while still present and unequally distributed, have eroded significantly. Technical barriers have been reduced through new, more “user friendly” technologies, and social barriers have been reduced by easy access to online, interest-driven communities [6].

Participation in such informal learning environments can have benefits for youth learning [8]. While schools have some

particular benefits for learning, as Heath [5] notes, “formal learning environments cannot easily give groups of young learners either truly meaningful roles or opportunities for participation in longitudinal projects.” Informal, out of school learning environments can provide powerful learning experiences for young people. In addition to providing a context for the development of knowledge and skills, they also provide a space for youth to explore and “figure out” their identities as thinkers and learners [3]. Moreover, deliberate learning within a learning ecology that spans multiple contexts, including formal and informal spaces, is commonplace for youth, particularly for learning about technology [1].

In the results below, we offer preliminary findings from our research on how youth understand themselves as participants in the maker movement.

## 4. METHODS

### 4.1 Broader Context of the Interview Data

The data we consider in this paper come from a descriptive, qualitative study of youth participants in *Maker Club* (a pseudonym). In this program, youth aged 12 to 18 years old work with adult mentors to conceptualize, design, and build a project of their own choosing, which they then exhibit at a large regional exposition of maker-type projects.

The study includes data collection from four case study groups. The case study groups, while not a representative sample in the statistical sense, were selected to provide a range of motivations, resources, roles, spaces and technologies that exist in youth-oriented making. The four groups vary in experience, size, and make-up (see Table 1). Two groups are working on collaborative projects involving the whole group. In the other two, participants are working individually or pairs on projects, but meet regularly as a larger group to share ideas and questions, learn new skills, gain access to tools and mentor expertise, and socialize. One group is made up of a teacher and her students who meet after school. Another group is composed of two sisters, with parents as

mentors. The other two groups are clubs made up of friends and acquaintances.

For each case study group, we interview youth, parents, and adult mentors, and we conduct periodic observations of making activities conducted in homes and at regional meet-ups.

### 4.2 Interview Data

We focus here on data collected from interviews with Maker Club youth participants. Seventeen youth participants (14 boys and 3 girls) have been interviewed so far. These interviews were completed early in the Maker Club program, as participants formulated project ideas and began to build. (Additional interviews are planned for later in project development.) We used a semi-structured interview protocol and interviewed youth individually or in pairs, as was convenient for them. Interviews lasted twenty to forty minutes and were audio taped.

In this paper we consider data gathered from two interviews questions. The first was, “Do you consider yourself to be a maker?” For those who said yes, we followed up with, “What is it about you that makes you a maker?” For those answering no, we asked, “Would you like to be a maker?” and “What would need to happen for you to be a maker?” For those who gave a qualified yes or no, we asked both follow up questions.

Our second question asked, “What kinds of making do you like to do?” As a follow up question, we asked, “Do you think of any of these as your specialty?”

After transcription of interviews, we conducted a content analysis of participant responses in order to examine ways in which the young people’s definitions and descriptions might align with and differ from educator and public perceptions of the maker movement, values and activities. We created preliminary categories from the data, and worked to collect these into themes stated at a more general level of description. We then searched across cases for confirming and disconfirming cases, revising the themes accordingly. Our analysis is ongoing, but we describe below themes that have emerged thus from our analysis.

**Table 1. Basic Descriptors of Case Study Groups**

Case Study Group	Group make up	Primary adult involvement	Project Structure; Focal technologies
Family-based	2 girls (sisters)	2 parent-mentors	Individual projects; Crafts, mechanics, sculpture
School-based	2 girls, 3 boys	1 teacher-mentor	Group project; mechanics
Club-based 1	5 boys	1 parent, 1 non-parent mentor	Group project; mechanics and electronics
Club-based 2	8 boys	1 parent-mentor, 1 mentor	Individual projects: mechanics, electronics, digital fabrication, electricity

## 5. RESULTS

Through our initial analysis of interview data, focused here on young people’s descriptions of themselves and their “making,” we have identified three emergent themes. We present these themes below, along with supporting quotes from interviews. These are empirically grounded results, but we nonetheless acknowledge the tentative nature of our findings at this stage of work, and stress our plans for further refinement of these themes through ongoing analysis.

### 5.1 Open Community, Active Participation

Of the 16 participants interviewed, 8 said that they would call themselves makers, 1 said “definitely not,” and the remaining 7 gave qualified answers. Those who gave qualified answers were particularly revealing about the characteristics of themselves and the label “maker” that they weighed in their responses. For example, responses included:

- “I consider myself to be an *amateur* maker... a regular maker is like those people who build like things that spit fire.” Garratt, age 11.
- “Most of the time, but sometimes I like to draw.” Corey, age 14
- “I’ve been in maker faire, and I have a badge that says ‘maker.’ So if you’re talking technical, yes. But I still do buy things.” Finn, age 14
- “In some ways I would say yes, because I like arts and crafts, and when I was a kid I did lots of Lego building, but in some ways no, because I don’t actually spend a lot of time making stuff. Brian, age 17.
- “I guess... but I think that to be a maker you have to make *lots* of things.” Joel, age 14.

While there is variation across responses, these youth appear to be considering a notion of membership based in both levels and types of participation. Identity as a maker seemed to be rooted in the creation of physical objects of a certain quality and to require a

certain threshold commitment – not just making one quick thing, but a significant amount of work over time.

Responses of the eight participants who answered, “yeah,” “sure,” or “yes” further affirmed the idea that being a maker was an active and ongoing endeavor. However, unlike the somewhat narrower conceptions just described, their descriptions of making and being a maker presented a wide scope of activities that focused on values and approaches to life, as much as they did on particular types of projects. For example, one young person mentioned the importance of making and fixing things, instead of “just buying them,” a value echoed by others. Another emphasized that makers like to build things and “come up with [their] own solutions to things.” Claudia, age 17, who is now in her third year in the program, said that makers are people who “aren’t scared to solve problems,” and emphasized gaining inspiration from other makers as part of becoming a maker. Other experienced Maker Club participants also mentioned aspects of problem solving and community learning.

The theme we extracted from these responses is that youth see making, and the maker community, as open to many forms of activity and many modes of participation. Nonetheless, a self-labeled maker should be active – making things, solving problems, and learning from the community.

## 5.2 Making in Contrast to the Normal

A number of our study participants characterized making, and being a maker, as distinctive from a normal, everyday, or common way of being. One young maker stated that the important part of making is:

*Mostly the making part. Just build some cool stuff that’s out of the ordinary, that people wouldn’t normally do because they see no point in it. In our modern society, like people don’t really have any need to make this out of the way crazy stuff, so we’re, our modern society is pretty much about going, going, going. But every once in a while you’ll walk into one of these [tech] shops and be like, ‘oh that’s really awesome. Let’s see if we can do something like that.’ Brett, age 15*

We see two versions of being non-normal. First, the created objects are “out of the ordinary.” Other participants expressed a similar idea, saying that making means you are “motivated to do something [away] from the normal everyday,” and that you do “something that not everybody really knows.” Second, making things rather than buying them is counter to typical ways of “modern society.” Across the sample, about a third of participants described some aspect of being a maker in contrast to a perceived eagerness, on the part of non-makers, to buy things.

From these responses, we extracted the theme that youth see making as distinctive and set in contrast to the mainstream. Here, making itself was unusual, in contrast to consuming, and the objects that makers like to make are typically creative and not ordinary. These ideas were common, but not universally expressed, across our sample.

## 5.3 Making is Integrated Across Contexts

When thinking about “making” as a class of activity, it is easy to describe it in one of two ways: either as a set of discrete, if complementary, skills (3D printing, welding, electronics, and so forth), or as an activity that takes place in certain kinds of settings (Maker Club, Maker Faire, etc.). When we asked our participants about the kinds of making that they did, we heard making described in these ways, but we were surprised by the number of participants who talked about their making in a highly integrated, “life-wide” fashion.

Many youth participants described activities that transcended the boundaries of particular projects, clubs, or fairs. For example, Corey intertwined his narrative of making with that of learning to play the guitar. He is currently “hacking” a guitar effects pedal to give new functionality to his amplifier. Playing guitar is not a canonical “making” activity, yet within this young man’s learning ecology, guitar playing and hacking electronics are compatible and complementary. From the participants’ responses, other activities that seemed to cross interest areas included computer arts and programming, building things to ride, writing stories, creating “fun little areas to be around,” and simply having lots of ideas.

Some participants explicitly addressed the generalizability of their making. Joel, in his first year with Maker Club, said “I think that’s also kind of what the maker movement is about: kind of having the skills to get by in a bunch of different like areas without having to ask someone else for help.” Jeanie, a more experienced participant, also saw her maker knowledge and skills as generalizable to other areas of her life, including school: “when you’re a maker it’s actually really helpful for other projects in your daily life. ... Like if you’re making some project for school, then it’s a lot easier to pick up ideas and solve problems and you get like more creative like through the process of making, because when you’re at maker faire you really practice all your problem solving and ideas, and it really helps.”

We interpret these examples as evidence for a third theme: many youth saw making as integrated across their experiences. We do not deny that some youth may see making as a distinct class of activity that only exists in certain spaces, but this view is not a necessity – some youth see making as transcending contextual barriers. It remains to be seen whether this integration is best thought of in terms of knowledge and skills, youth identities, discourse processes, dispositions, or something else.

## 6. DISCUSSION AND CONCLUSION

For many educators, the attraction of making is its alignment with STEM disciplines. While we share that excitement, we caution against a reductive treatment of making as a set of component knowledge and skills.

One of the distinctive aspects of the modern resurgence in making, which takes it beyond the longstanding hobbies on which it is built, is the emergence of a strong community of self-identified makers connected through social networks online and elsewhere. As educators consider the potential benefits of making for student learning, we believe it is critical to attend not only to the knowledge and skills that youth may acquire through making, but also to their sense of themselves as participants within a broader community.

We believe it is vital to understand how young people who are involved in making understand the work and culture of making. Perceptions and conceptions of making shape activity and positioning within maker activity spaces, and may reflect ways in which the technological, social, and cultural tools of “making” are taken up and appear in other domains. Efforts to tie making more narrowly to STEM outcomes or to assume uniform outcomes in any particular area of learning may limit the openness of maker definitions, leave less room for exploration and personalization, and erode the value youth see in participation.

Instead, we advocate here for a more holistic, youth-centered view of the role and value of making as an educative experience. In this paper, we drew from interviews with seventeen youth participants in Maker Club to extract three emergent themes. In brief, youth

see making as diverse, active, out of the mainstream, and integrated across life contexts.

In our ongoing work, we will continue to refine our understanding of young people's perspective on making. We will also consider data that speaks to how young people's views change over time and with experience, especially with the experience of presenting their projects. In addition, we will expand our consideration of youth views to examine youth attitude and approach toward failure, problem solving, persistence, and metacognition, as well as the uptake and use of language patterns common among adult participants in Maker Club and the broader maker movement.

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Learn how the Maker Movement is inspiring students to be our future creators and better students today.Â But today, there seems to be an increasing number of makers among our youth â€“ enough to comprise a â€œmovement.â€What is this Maker Movement all about? The Maker Movement can mean different things to different people, but essentially it refers to embracing the ability to create useful things from scratch. In the past, â€œmakingâ€ technology or advanced products required knowledge and access â€“ things only available to professionals. Today, however, the possibilities are endless. We have everything from your basic needle and thread to more advanced maker tools, like the Raspberry Pi, Arduino, and 3D printers. Students on Team Stria have fun while doing the serious work of designing technologies to help the blind. Last fall, Project Invent introduced a group of high school students to Jimmy, a 29-year-old man who recently became blind and was struggling with veering into traffic on his walks. These students took on the challenge of designing a solution to help blind people everywhere with the dangerous problem of veering. We didnâ€™t tell them what to make â€“ students decided what problem they wanted to tackle and how to best solve it. These students, and many others in Project Invent, have already designed impactful technologies to address everything from social anxiety to sexual assault to PTSD. And behind every teamâ€™s inventions are stories of real people in their community. While the maker movement is characterized by adult participation, barriers to youth involvement, while still present and unequally distributed, have eroded significantly. Technical barriers have been reduced through new, more â€œuser friendlyâ€ technologies, and social barriers have been reduced by easy access to online, interest-driven communities [6].Â However, unlike the somewhat narrower conceptions just described, their descriptions of making and being a maker presented a wide scope of activities that focused on values and approaches to life, as much as they did on particular types of projects. For example, one young person mentioned the importance of making and fixing things, instead of â€œjust buying them,â€ a value echoed by others.